



Effects of fillers on the properties of liquid silicone rubbers (LSRs)

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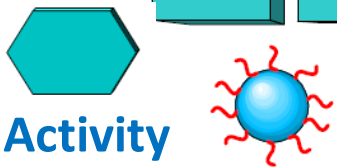
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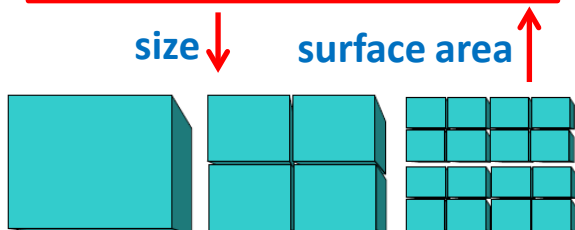
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Effects of Fillers Depend On

Particle Size 
Particle Surface Area 
Particle Shape 
Particle Surface Activity
 (Compatibility With/Adhesion To Matrix)

Particle Size
Smaller is Better
 >10 μ m: Degradants
 1-10 μ m: Diluents
 0.1-1 μ m: Semi-reinforcing
 0.01-0.1 μ m: Reinforcing

Particle Surface Area
Bigger is Better



Particle Shape

Broader (and Longer) is Better

Isometric



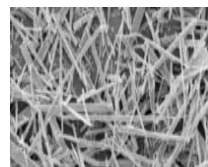
Platy



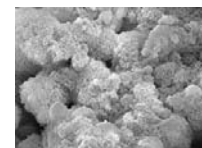
Fiber



Acicular



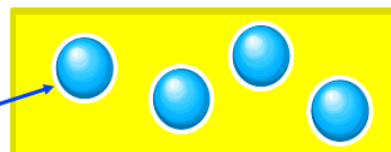
Cluster



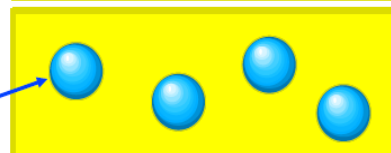
Particle Surface Activity

More is Better

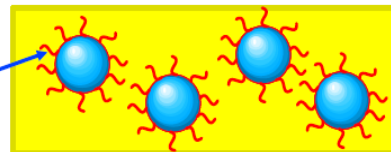
Poor contact



Good contact



Bonded



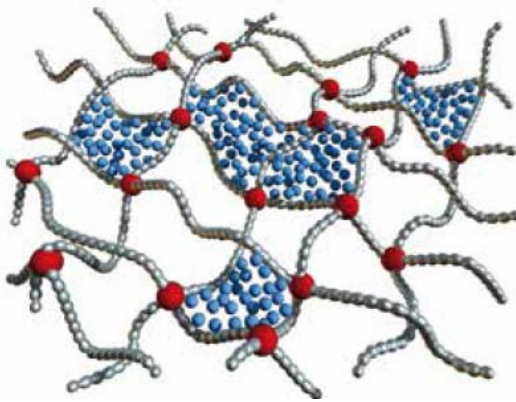
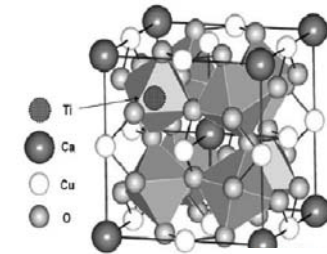
Matrix wetting

Matrix adhesion

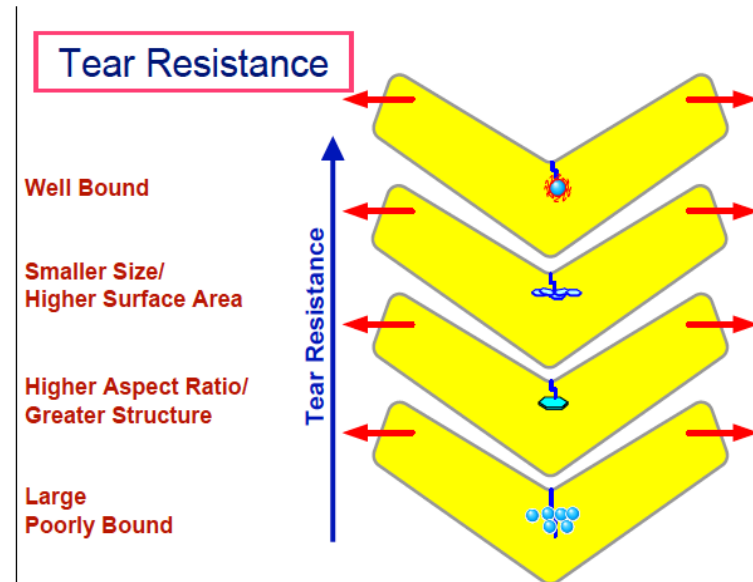
SiO₂ reinforces the networks with no increase in **permittivity** ($\epsilon_{r, \text{SiO}_2} \sim 3.9$).

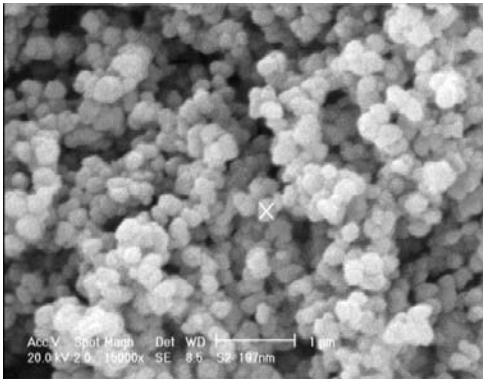
The **inhomogeneous** compatibility of the **unmodified multiwalled carbon nanotubes (MWCNTs)** causes the risk of **conductivity**.

Micron-sized CaCu₃Ti₄O₁₂ CCTO ($\epsilon_{r, \text{CCTO}} \sim 10000$) decreases the **mechanical properties** of the composites.

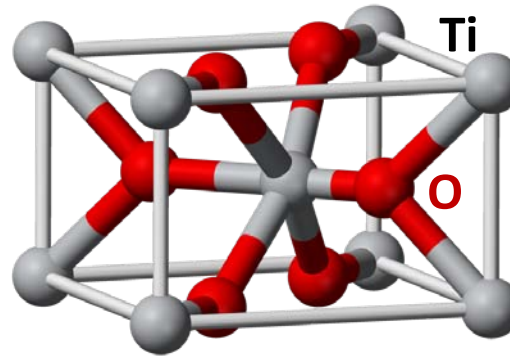


Polymer with chemical crosslinks (**red**) forms a filled, elastic network

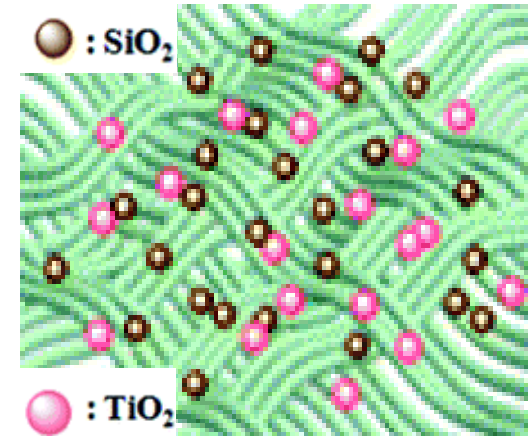




Nano-sized: 25-250nm
Spherical particle



Rutile ϵ_r : 114-180
Hydrophobic: modified polysiloxane



	Tear strength (N/mm)	Relative permittivity ϵ_r @ 0.1Hz	Young's modulus Y (MPa)	Breakdown strength (V/μm)
LSR	6.6	2.8	0.8	130
LSR/TiO ₂	20	5.5	1.0	150

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